Distributed Generation Systems

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Distributed Generation Systems					
Fuel Cells	66,833	74,428	65,000	-9,428	-12.7%
Novel Generation	2,401	2,958	0	-2,958	-100.0%
Total, Distributed Generation Systems	69,234	77,386	65,000	-12,386	-16.0%

Description

The objectives of the Distributed Generation Systems Fuel Cell activity are to provide the necessary technology base development of fuel cell systems for electric utility, industrial, and commercial/ residential markets; and to provide technologies that improve U.S. international competitiveness in this new manufacturing industry.

Benefits

Distributed generation (DG) complements electricity supply from central generation systems by providing another source of energy through smaller-scale production of electric power in stationary plants at or near the end user. Fuel cells as small modular resources may be used on a stand-alone basis, or integrated with other generators, and even connected to a central system grid. These systems may be owned and/or operated by utilities, utility customers, and third parties. Fuel cell systems are capable of reducing criteria pollutants well below current New Source Performance Standard levels, reducing non-criteria pollutants such as CO_2 and acid rain precursors, and reducing thermal emissions to the environment. Fuel cell systems provide important carbon management options because of their inherently low emissions and ultra-high efficiency, and they can be operated in areas where water resources are scarce since they do not require water for operations, but rather produces water as a by-product.

Fuel cell applications in distributed generation systems offer potential opportunities for cost-effectively meeting peak demand without the need for costly investments in transmission and distribution. They can be used to provide clean power to remote end users; and can provide new business opportunities to both utility and non-utility owners.

Fuel cell modules in IGCC and FutureGen systems have the potential to double the efficiency of coal-based systems and achieve near-zero emissions. Fuel cells can concentrate CO_2 which lends itself to removal by separation or other capture means. Fuel cells provide a bridge to the hydrogen economy by using coal derived hydrogen to produce power efficiently and by offering the potential to produce hydrogen, as well as electricity, from coal. By the electrochemical reaction similar to the phenomenon that takes please in a battery, a fuel cell can operate continuously when it is fed hydrogen that reacts with oxygen to product electrons for making electricity. By the reversal of this process, i.e., the input of electricity through a fuel cell operating in “reverse”, one can also produce hydrogen.

Background

Fuel cells and other innovative power systems are being developed for distributed generation applications that can create public benefits by enhancing the overall efficiency, security and reliability of the Nation's energy supply. The Fuel Cells Program supports the President's climate change goals by increasing the efficiency of electricity production, creating the potential for over 50% reduction in CO_2. It supports the Clear Skies Initiative with near zero emissions of NO_x, SO_x, and no mercury emissions, and it supports energy security goals by providing distributed generation alternatives to grid-based power and through multi-fuel capability (less dependence on one fuel). High-temperature fuel cells can operate on hydrogen and hydrogen carriers such as methane and syngas. Low-cost, ultra-high efficiency, fuel flexible, integrated fuel cell and fuel cell/turbine hybrids systems for synfuel and hydrogen-based plants will provide essential power modules for FutureGen projects and zero emissions concepts in the 2010 to 2015 time frame. Hence, the Distributed Generation Program is a bridge to the hydrogen economy of the future envisioned in the FreedomCAR and Hydrogen Fuel Initiatives.

The Fuel Cells Program is leveraging technical innovation to develop advanced power systems for distributed generation that will improve power quality, boost system reliability, reduce energy costs, and help delay/defray capital investments. The program goal is to develop low-cost, high efficiency, fuel flexible, modular power systems with lower cost, higher quality electricity, and significantly lower carbon dioxide emissions than current plants, as well as near-zero levels of pollutants.

The current strategy is to develop clean high efficiency fossil fueled power plants: Immediate near-term (2006-2007) - validate successful Solid State Energy Conversion Alliance (SECA) Phase I achievements and initiate Phase II SECA low-cost, 3-10 kilowatt solid-state fuel cell modules for distributed and auxiliary power unit applications; Validation of target achievements will be done via testing of the first prototype fuel cells to confirm the first plateau of performance (current density, hours of operation) and analyzing the design and cost reduction potential using the system components. If the fuel cell prototype passes the first "gate" it will qualify for a second phase development aimed at further performance improvements and cost reduction designs that will be tested and analyzed at the end of the second phase before: Mid-term (2007-2010) - develop and test SECA fuel cell prototype modules capable of manufacture of $400 per kilowatt (a ten-fold reduction from the 2004 cost); and Long-term (2010-2015) - scale-up and demonstrate the critical high risk technology advancements which will permit U.S. industry to establish commercial availability of advanced, low-cost, ultra-high efficiency, fuel flexible, integrated fuel cell and fuel cell/turbine hybrids systems for synfuel and hydrogen-based plants. Fuel cell systems have specifically identified goals which coincide with coal-based and other fuel-flexible zero emissions power modules and concepts in the 2010 to 2015 time frame.

The Innovative Concepts subactivity includes the Solid-State Electricity Conversion Alliance (SECA), the Department's major initiative for stationary fuel cells development. The Department is consolidating all fuel cell efforts under the Innovative Concepts subactivity, in support of the $400/kW SECA fuel cell system, because it is the most promising long-term, high-risk, high-gain area for fuel cell research, in accordance with the R&D Investment Criteria. The objective of the SECA is to drastically reduce fuel cells costs to make them a broadly applicable and more widespread commodity in the competitive, mature distributed generation and auxiliary power markets. The SECA program incorporates an integrated strategy to address the technical barriers of solid-state fuel cell systems within

the cost constraint of $400 per kilowatt for a complete system. The benefits of SECA, from only the distributed generation market sector, are projected by NEMS to include up to $29 billion in savings through Clear Skies and Climate Change emissions reductions by 2025 - from up to 87 GW of SECA fuel cell capacity. Significant additional savings and installed capacity result from SECA fuel cells being incorporated into advance coal gasification plants over this same time period. Additional management benefits can be expected to accrue with the introduction of SECA hybrid systems. Work under SECA core program include, gas processing (reforming and cleanup), power electronics, controls and diagnostics, heat recovery, modeling and simulation, and material and manufacturing/fabrication research at universities and national laboratories. The highest priority core technology work is focused on seals and interconnects. SECA industry teams are engaged in the development of common modules for diverse applications in multiple and mobile market applications. SECA includes exploration of designs that combine functions to reduce size, weight, and costs. A new effort began in FY 2005with a solicitation to develop mega watt-scale SECA systems work in support of FutureGen. Fuel cell and fuel cell hybrid systems are expected to be available for testing at FutureGen and other sites in the 2010 to 2015 time frame.

Molten carbonate and tubular solid oxide programs are no longer funded since they have reached conclusion. The Department considers these technologies at a point of development where industry can pursue their commercial development without further Federal funding.

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
Fuel Cells	**66,833**	**74,428**	**65,000**

The focus of the Fuel Cells program is to reduce cost by an order of magnitude enabling the widespread deployment of clean reliable fuel cells and fuel cell hybrids for distributed generation, FutureGen, and Vision 21 applications through low-cost, ultra-clean, and ultra-high efficiencies.

Advanced Research	**9,611**	**12,205**	**0**
▪ **Advanced Research**	**9,513**	**12,083**	**0**

In FY 2006, no additional work is planned in this category. Funds have been redirected to the $400/kW SECA fuel cell under the Innovative Concepts subactivity.

In FY 2005, complete work on high temperature electrochemical research will be conducted at HiTEC at PNNL, Montana State University and the University of Florida. *Participants included: PNNL, Montana State University, University of Florida, NETL, TBD.*

In FY 2004, funded research to develop a fundamental understanding of processes that limit the performance of high temperature electrochemical systems. Such systems have applications in fossil energy conversion, energy storage, and electrolysis. Parallel experimental and modeling activities, research conducted by HiTec will eventually lead to new concepts and technologies in fossil fuel utilization. *Participants included: PNL, NETL, Ion America, Cal Tech.*

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
▪ **Program Support**	**98**	**122**	**0**
Fund technical and program management support.			
Fuel Cell Systems	**10,567**	**2,958**	**0**
▪ **Fuel Cell Systems**	**10,459**	**2,928**	**0**
In FY 2006, no additional work is planned in this category. Funds have been redirected to the $400/kW SECA fuel cell under the Innovative Concepts subactivity.			
In FY 2005, FCE will complete its work on the Montana Hybrid project. *Participants include: Fuel Cell Energy, NETL.*			
In FY 2004, with the conclusion of molten carbonate fuel cells stack development in FY 2003, this subactivity will support advanced fuel cell systems development and testing in a variety of crosscutting areas in FY 2004. *Participants included: Fuel Cell Energy, NETL.*			
▪ **Program Support**	**108**	**30**	**0**
Fund technical and program management support.			
Vision 21 Hybrids	**12,488**	**5,029**	**0**
▪ **Vision 21 Hybrids**	**12,360**	**4,979**	**0**
In FY 2006, no additional work is planned in this category. Funds have been redirected to the $400/kW SECA fuel cell under the Innovative Concepts subactivity.			
In FY 2005, the work on tubular SOFC at SWPC will complete its transition to SECA.			
In FY 2004, conduct a redirected Vision 21 enabling cost reduction and performance enhancement program with low-cost Vision 21 fuel cell/turbine hybrid technologies; explore Vision 21 zero-emissions system concepts; conduct system studies and explore fuel flexibility and integration issues as permitted. *Participants include: NETL, GE, FCE, Siemens.*			
▪ **Program Support**	**128**	**50**	**0**
Fund technical and program management support.			
Innovative Systems Concepts	**34,167**	**54,236**	**65,000**
▪ **Innovative Systems Concepts**	**33,816**	**53,694**	**64,350**
In FY 2006, complete prototype tests, validating successful industrial team achievement of SECA Phase I technical requirements for low-cost fuel cell systems; continue SECA core technology R&D to resolve any remaining crosscutting technical issues, such as seals and interconnects and to enhance individual subsystem components and overall system performance to position teams to achieve Phase II intermediate goals and the final SECA system 2010 goal of $400/Kw; continue			

(dollars in thousands)

FY 2004	FY 2005	FY 2006

MW-scale SECA fuel cell and fuel cell hybrids work in support of coal-derived gas-based, FutureGen Fuel Cell systems under the Fuel-Cell Based Central Power System Development solicitation. *Participants include: GE, Siemens Westinghouse, Delphi, FCE/MSRI, Acumentrics, Cummins-SOFCo, PNNL, ANL, NETL, and other core technology participants.*

In FY 2005, begin prototype validation of Phase I technical requirements for low-cost SECA fuel cell systems; enhance individual components and systems performance; conduct SECA core technology R&D to resolve crosscutting technical issues; develop innovative reformers, sensors, and controls; initiate designs of coal-derived gas-based SECA systems as permitted. Initiate MW-scale SECA hybrids work in support of coal-derived gas-based, FutureGen Fuel Cell systems under Fuel-Cell Based Central Power System Development solicitation. *Participants include: GE, Siemens Westinghouse, Delphi, FCE/MRI, Acumentrics, Cummins-SOFC, PNNL, ANL, NETL, and other core technology participants.*

In FY 2004, **SECA** - Developed four concept designs for prototype mid- to high-temperature low-cost solid state fuel cell systems; developed SECA core technology for materials to reduce manufacturing costs, enhance performance, and develop innovative sensors and converters; initiated designs of hybrid coal-based SECA systems. *Participants include: GE/Honeywell, Siemens Westinghouse, FCE/Versa Power, Acumentrics, Delphi, Cummins-SOFC, ANL, PNNL, NETL, and other core technology participants.*

▪ **Program Support**.....	**351**	**542**	**650**

Fund technical and program management support.

Novel Generation	**2,401**	**2,958**	**0**
▪ **Ramgen**.....	**2,376**	**2,928**	**0**

In FY 2006, no funding is requested. In accordance with the RU&D Investment Criteria, Ramgen will no longer be funded through direct sourcing. Ramgen is eligible for funding through a competitive, merit-based process under the Turbines program.

In FY 2005, complete work on the RamPressor. *Participants include: Ramgen.*

In FY 2004, continue to openly solicit new fossil-fuel based power generation technology that shows promise of improving efficiencies and/or lower emissions through the novel concepts program. *Participants to be determined*.

▪ **Program Support**.....	**25**	**30**	**0**

Fund technical and program management support.

Total, Distributed Generation Systems.....	**69,234**	**77,386**	**65,000**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Fuel Cells	
Advanced Research	
▪ Work ended at HiTEC in FY 2005	-12,083
▪ Program Support	-122
Total, Advanced Research	-12,205
Fuel Cell Systems	
▪ Montana hybrid effort completed in FY 2005; no additional funding required	-2,928
▪ Program Support	-30
Total, Fuel Cell Systems	-2,958
Vision 21 Hybrids	
▪ Tubular SOFC work at SWPC transitioned to SECA; no additional funding required	-4,979
▪ Program Support	-50
Total, Fuel Cell Systems	-5,029
Innovative Systems Concepts	
▪ Increase will maintain SECA program on schedule	+10,656
▪ Program Support	+108
Total, Innovative Systems Concepts	+10,764
Novel Generation	
• Work at Ramgen concluded in FY 2005	-2,928
• Program Support	-30
Total, Novel Generation	-2,958
Total Funding Change, Distributed Generation Systems	**-12,386**